California Levee Vegetation Research Program
Informational Circular No. 3:
New Research and Next Steps
August 4, 2014

Following the Levee Vegetation Research Symposium 2012 held August 28-30, 2012, the California Levee Vegetation Research Program (CLVRP) planning team reconvened to plan new research on the effects of trees on levees as well as to incorporate recent research findings into new levee management policies and practices. This Informational Circular No. 3 summarizes the program's progress to date.

COMPLETED RESEARCH

Since 2008, the CLVRP has conducted original research, produced numerous findings, reports, and peer-reviewed publications, and developed improved modeling techniques. Reports at or near completion are listed below. A link to completed manuscripts can be found at: www.safca.org/Protection/Environmental_CLVRP_Research.html.

Completed Research Reports

- *Habitat Associations of Burrowing Mammals along Levees in the Sacramento Valley, California.* Dr. Dirk Van Vuren and Miguel A. Ordeñana, UC Davis
- *Influence of Adjacent Crop Type on Occurrence of California Ground Squirrels on Levees in the Sacramento Valley, California.* Dr. Dirk Van Vuren et al., UC Davis
- *Influence of Tree Roots and Mammal Burrowing Activity on Levee Performance: Volume II – Parallel Trench Wetting Front, North Levee of the American River at Cal Expo Sacramento, CA.* Dr. Michelle Shriro et al., UC Berkeley
- *Burrow Dimensions of Ground Squirrels, with Special Reference to the California Ground Squirrel.* Dr. Dirk Van Vuren and Miguel A. Ordeñana, UC Davis
- *Investigation of Tree Root Penetration into a Levee Soil-Cement-Bentonite Slurry Cutoff Wall, Part I and Part II.* Dr. Les Harder, HDR, Inc. et al.
- *Windthrow Potential on Levees: Stability of Two Species of Central Valley Trees on River Levees, Evaluated by Static Winching Tests*. Dr. Chris Peterson et al., University of Georgia
- *Influence of Vegetation on Levee Past Performance*. Dr. Sujan Punyamurthula et al., URS Corp.

Root architecture excavation near Vernalis, CA

Research Reports Coming Soon

- *Influence of Tree Roots and Mammal Burrowing Activity on Levee Performance: Volumes I, III – VI*. Dr. Diego Cobos, Dr. Michelle Shriro, Dr. Nicholas Sitar, Dr. Jonathan Bray, UC Berkeley
- *Three-Dimensional Imaging, Change Detection, and Stability Assessment during the Centerline Trench Levee Seepage Experiment Using Terrestrial Light Detection and Ranging Technology, Twitchell Island, California, 2012*. Dr. Gerald Bawden, USGS
- *Tree Root Architecture – How and where do tree roots grow in levees?* Dr. Alison Berry et al., UC Davis

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ACCOMPLISHMENTS

Congratulations to our researchers who started their work as doctoral candidates and used their findings from the CLVRP studies to develop their thesis papers and attain their PhDs. Michelle Shriro and Diego Cobos of UC Berkeley focused on the influence of tree roots and burrowing mammals on levee performance, and Shih-Ming Chung of UC Davis focused on modeling root architecture in levees. They have all moved on to professional careers in California and abroad.

Dr. Michelle Shriro   **Dr. Diego Cobos**   **Dr. Shih-Ming Chung**

NEW PROJECTS, RESEARCH & UPDATES

In fall 2012, the CLVRP and representatives of State and federal partner agencies met to examine remaining data gaps on levee vegetation and assess future research needs which were characterized into two areas:

1. Packaging of existing levee vegetation knowledge in a way that summarizes relevant research results and develops recommendations and procedures that can be put in use on the ground by levee managers.
2. New research.

These gaps and needs are being addressed by the following working groups and research:

A. Vegetation Assessment Working Group

The task of the Vegetation Assessment Working Group, a subgroup of the CLVRP, is to utilize the most recent research to recommend updated policies and procedures for ongoing monitoring and management of levee vegetation. The group is currently developing recommendations for the California Department of Water Resources for implementation as follows:

1. Tree Threat Assessment Approach: Using the best available knowledge, a field procedure is being developed that will identify trees that pose an unacceptable risk to levee integrity. Remediating hazard trees can include vegetation maintenance practices such as coppicing and crown thinning. Appropriate guidance will be developed for these practices, including tree removal, where necessary.

2. Levee Vegetation Data Collection Procedures
   a. Development of *Standardized Field Data Collection Procedures*: These procedures will serve as the foundation for future statistical studies by helping to standardize and improve data collection.

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b. **Tree-fall Data Rapid Response:** Develop a mobile research team poised to deploy soon after trees on levees fall to collect real-time data including, root pit measurements, soil compaction, soil saturation, tree species, and condition. Collected data will be used in future analyses and research.

B. Synthesis Report: Levee vegetation research – What does it all mean?

Following the 2007 levee vegetation symposium, considerable research on levee vegetation was conducted by the CLVRP, the U.S Army Engineer Research Development Center (ERDC), other U.S scientists, and European scientists. In consultation with scientists studying various aspects of levee vegetation effects, the CLVRP is producing a synthesis of key findings of selected research with emphasis on recent findings from 2007 to 2013. The purpose of the synthesis report is to combine the findings of the principal investigators who are separated by discipline and geography, as well as identify questions for which a consensus answer has emerged, data gaps, and issues that remain controversial or unresolved. Expected draft completion date: Fall 2014.

C. Evaluation of the Incremental Risk of Levee Failure Due to the Effects of Woody Vegetation

This study, conducted by UC Berkeley, will use a peer-reviewed risk assessment methodology that utilizes established and professionally accepted methods to evaluate the risk of failure of selected representative levees in California's Central Valley. Specifically, the focus of the study is to develop best possible analysis of the incremental risk of levee failure due to the effects of vegetation for several case study levees, using updated analytical tools and incorporating the most recent scientific knowledge from CLVRP studies and others.

The primary outcome of the study will be estimates of the impacts of levee vegetation on different potential failure modes that might affect levee integrity and the overall probability of failure. A second outcome will be the identification of the relative risk of vegetation in comparison to established failure modes and/or risk factors (e.g. underseepage,

Parallel trench wetting front study in Sacramento, CA

through-seepage, slope instability, and erosion). In addition, a description and discussion of analytical methods and tools will support the findings. Expected completion date: Winter 2017.

D. White Paper: Impact of Vegetation on the Geotechnical Performance of Levees

Based on a previous analysis and summarized in the report *Influence of Vegetation on Levee Performance in California*, forty two (42) points of interest (POIs) were identified where vegetation was perceived to have influenced the past performance, reliability, and safety of levees. Of these 42 POIs, twenty three (23) POIs were identified where the information about the impact of vegetation on levee performance was inconclusive. The objective of this task is to analyze these 23 POIs in greater detail and to substantiate or clarify the previous findings. Expected completion date: Winter 2015.

E. Washington State SWIF Process and Studies

King County Flood Control District in Seattle, Washington has initiated a Systemwide Improvement Framework (SWIF) process for major reconstruction of their Green River levee system. As a part of this process, staff from the Water and Land Resources Division is working with U.S. Army Corps of Engineers (USACE) and other agency partners to develop a Vegetation Management Framework. This Framework

is comprised of multiple objectives and will provide a vision and guidance for levee system management. This guidance will include incorporation of vegetation into their levees as well as direction for managing levee vegetation for flood-fight accessibility, visibility, and environmental enhancement. The Vegetation Management Framework is approximately 50% complete and a draft is expected by February 2015. King County is also sponsoring two studies that may inform future shoreline vegetation management decisions: graduate research regarding the effects of vegetation on levee stability, as well as analysis of the effects of bioengineered levees on habitat and fish use. For more information, please contact Mark Isaacson, Water and Land Resources division director at (206) 477-4601.

F.   U.S. Army Engineer Research and Development Center (ERDC)

In Fiscal Year 2013, ERDC conducted research on two research areas: (1) pits produced from overturned woody vegetation, and (2) the applicability of bridge scour equations to calculate scour around a tree on a levee. The purpose of the research is to provide additional information required in the policy guidance letter of the USACE vegetation variance request. Two separate technical reports will be produced from this research. *Development of Envelope Curves for Predicting Void Dimensions from Overturned Trees* is complete and can be found here: http://acwc.sdp.sirsi.net/client/search/asset/1035683. The second report is currently in technical review.

The focus of a third research area is the compilation of vegetation observations on levees in a single report. Vegetation observations are being gathered from every USACE district on levees that are under the federal program for levee rehabilitation (Public Law 84-99).

RECENT LEGISLATION

On June 10, 2014, President Obama signed the Conference Report on H.R. 3080, the Water Resources Reform and Development Act of 2014 (WRRDA). Passed with bipartisan support from both the Senate and the House, the passage of this act will allow for investment in flood protection systems and other water projects throughout the country. In particular, WRRDA authorizes critical flood protection projects in California's Central Valley.

WRRDA also addresses the U.S. Army Corps of Engineers' (USACE) levee vegetation policy. The act calls for USACE to "consider factors that promote and allow for consideration of variances from guidelines on a … regional … basis" and "to solicit and consider the views of independent experts on the engineering, environmental, and institutional considerations underlying the guidelines ..."

USACE is charged with the responsibility of enacting the laws laid out in WRRDA and will carry out this responsibility through the issuance of implementation guidance for WRRDA's various provisions. As USACE develops this guidance, stakeholders and partners from the non-Federal and private sectors will have the opportunity to provide comments and views through webinar listening sessions as well as in writing.

COMING SOON

More information about the CLVRP and related levee vegetation topics will be available soon on the CLVRP website that is currently in development.

ABOUT THE CALIFORNIA LEVEE VEGETATION RESEARCH PROGRAM

The CLVRP is a partnership of policy makers, levee managers, and researchers within federal, state, and local agencies formed to conduct original scientific research to address vegetation policy issues affecting the state and federal levee systems in California. The CLVRP is committed to undertaking research in a collaborative environment that builds upon existing knowledge about vegetation and its effects on levees. This research is being used to develop scientifically-based levee management policies and practical maintenance procedures that balance public safety, environmental stewardship, and economic stability.

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